Enhance System Test & Evaluation from development to battlefield via Technology Integration with Maintenance Test and Training

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Enhance System Test & Evaluation from development to battlefield via Technology Integration with Maintenance Test and Training

AGENDA

➔ Impetus
➔ Technology Overview
➔ Plan and Approaches

Developmental and Operational Tests & Evaluation Issues

❏ No integrated system-level developmental and operational test and evaluation mechanisms

❏ No planned database to track the developmental test and evaluation data to support operational test and evaluation

❏ No onboard system capable of evaluating the health of weapon systems for battlefield decisions and logistics planning

❏ High no evidence of failure (NEOF), maintenance training cost, and maintenance costs

❏ Traceability from performance parameters to end design is not structured

DT/OT Problems for Military Systems are Generic Across the Services and Systemic of the Way We DO BUSINESS. Major Changes are Required!

<u>System Battle Damage Assessment (BDA) and Repair Training Issues</u>

- ➢ No Technical Manual (TM) for BDA and no or inadequate system-level interactive electronic TM
- ➢ No formal integration of IETM and Training Materials
- ➢ No planned database to track BDA data to support development of the BDA and Repair (BDAR) TM
- ➢ No onboard system capable of evaluating the health of weapon systems for battlefield damage assessment and associated logistics requirements
- ➢ High cost BDA and high repair training cost
- ➢ Traceability from performance parameters to end design is not structured to support BDA

BDAR Problems for Military Systems are Generic Across the Services and Systemic of the Way We DO BUSINESS. Major Changes are Required!

Maintenance Test Issues/problems

✓ **No integrated system diagnostics/prognostics**
✓ **No onboard system capable of evaluating the health of weapon systems for battlefield decisions and logistics planning**
✓ **High no evidence of failure (NEOF), maintenance training cost, and maintenance costs**
✓ **High mean time to repair and low system mission readiness**
✓ **Time consuming troubleshooting and inadequate IETMs and high cost TPS development**
✓ **Time consuming parts ordering and high error rate**

> *Maintenance Test Issues for Military Systems are Generic Across the Services and Systemic of the Way We DO BUSINESS. Major Changes are Required!*

The Time for Dramatic Changes is NOW!!

➢ **Software Technology has been revolutionized in the past decade:**

   Object Oriented Programming, Client-Server Software, True Open Architecture, Integrated Data Environments, Platform Independent Software, Internet and Intranet communications, Visual Programming, OLE,DLL, Active-X, etc.

➢ **Most military software is antiquated, and will be updated over the next decade to take advantage of these advances**

➢ **OPPORTUNITY EXISTS NOW TO CHANGE FUNDAMENTAL BUSINESS CONCEPTS**

➢ **Unfortunately most automation programs are automating the same technology/business process**

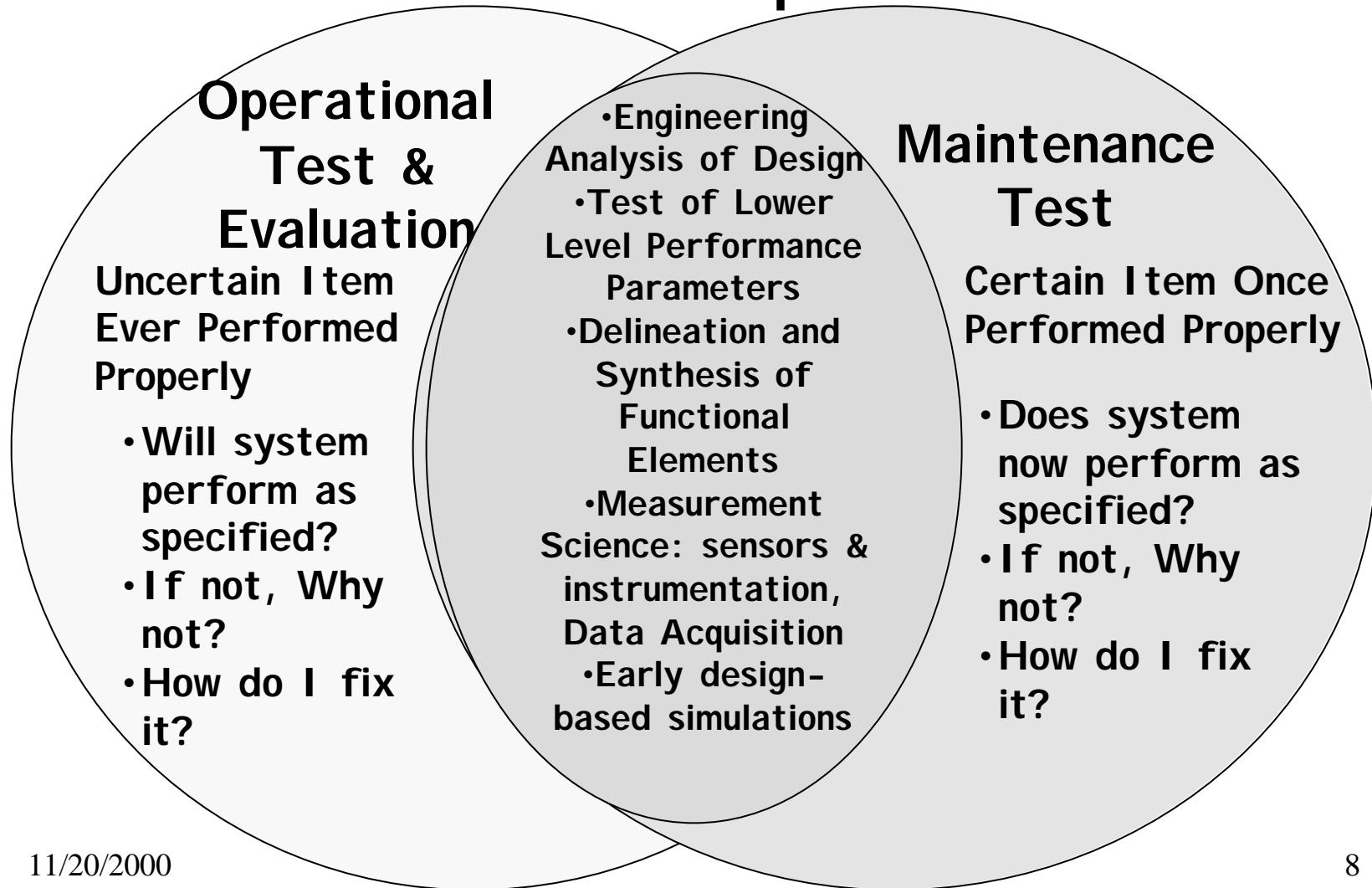> _The OPPORTUNITY for Re-Defining Fundamental practices is being MISSED!_

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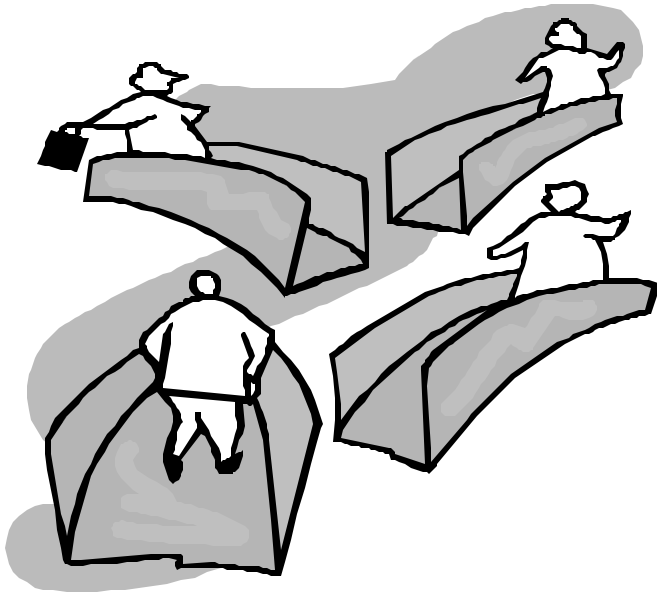
The time and the state of technology may be right for T&E, Maintenance Test, and BDAR communities to stop going in different directions...

...and converge on a common, information-driven approach to test requirements

Test Domain
Does System/Item Meet Specified Performance Requirements?

Operational Test & Evaluation

Uncertain Item Ever Performed Properly

- Will system perform as specified?
- If not, Why not?
- How do I fix it?

- Engineering Analysis of Design
- Test of Lower Level Performance Parameters
- Delineation and Synthesis of Functional Elements
- Measurement Science: sensors & instrumentation, Data Acquisition
- Early design-based simulations

Maintenance Test

Certain Item Once Performed Properly

- Does system now perform as specified?
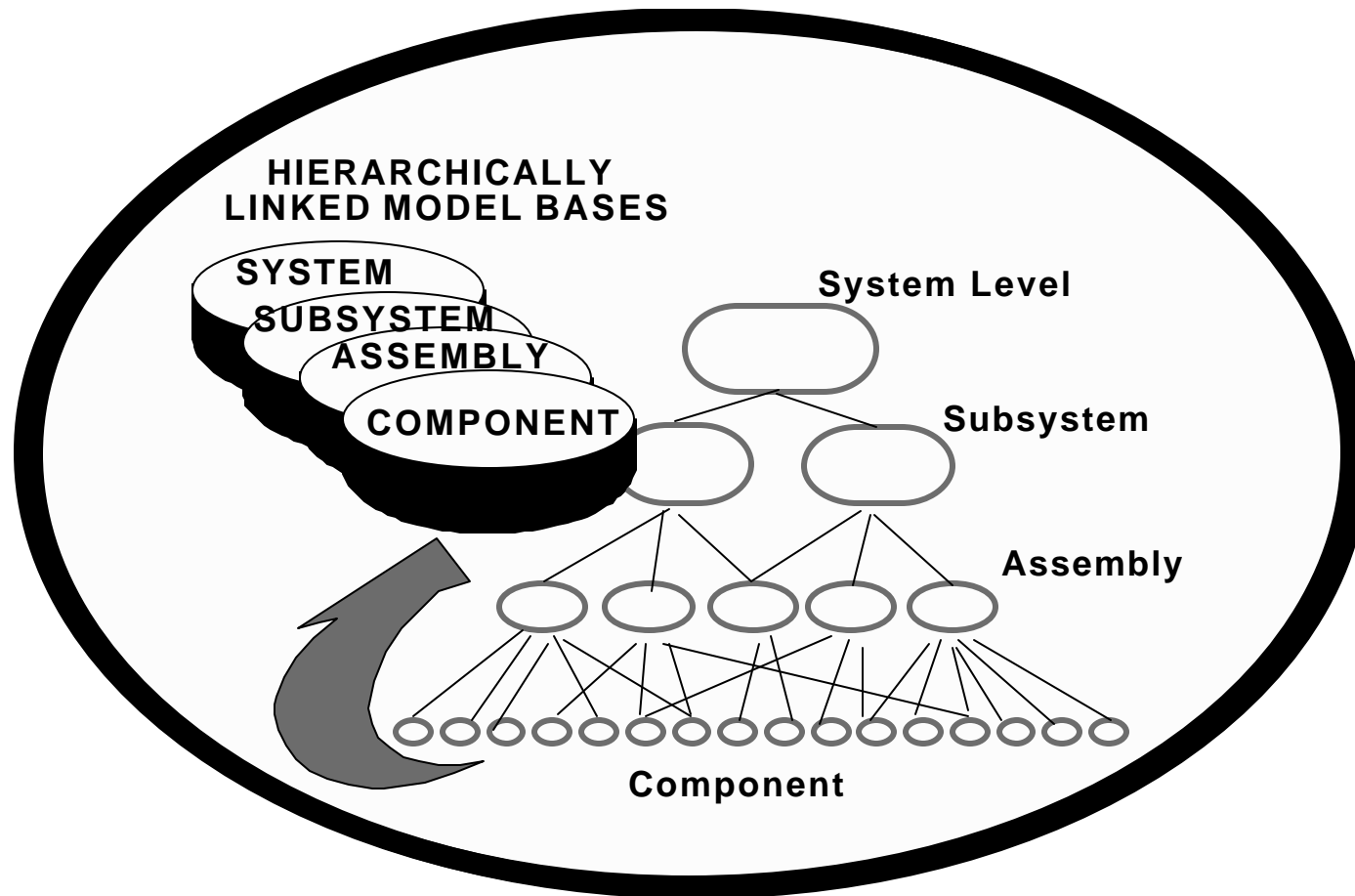- If not, Why not?
- How do I fix it?

COMMON TEST DOMAIN FOR MAINTENANCE AND D/O TEST AND EVALUATION

➢ **Engineering Analysis of system's design**
➢ **Test of lower level performance parameters**
➢ **Delineation and synthesis of functional elements**
➢ **Measurement Science: Sensors, instrumentation, and data acquisition**
➢ **Early design -based simulations**

How do we more effectively and efficiently leverage off these common elements ?

Imagine, if you will...

HIERARCHICALLY LINKED MODEL BASES

SYSTEM
SUBSYSTEM
ASSEMBLY
COMPONENT

System Level
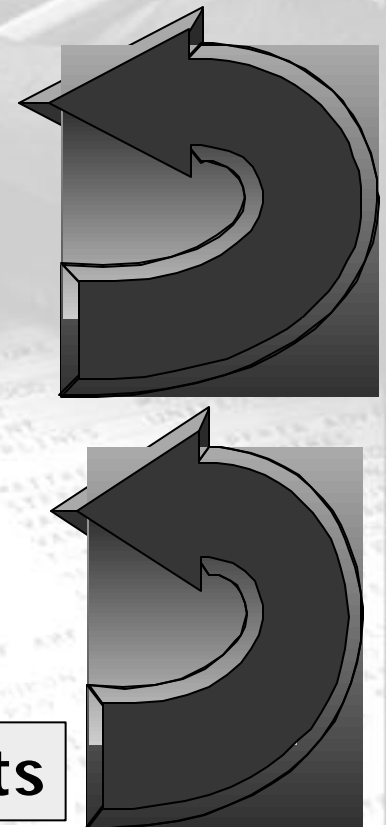
Subsystem

Assembly

Component

...A design-based model...

… that correlates design elements to system functions to mission performance…
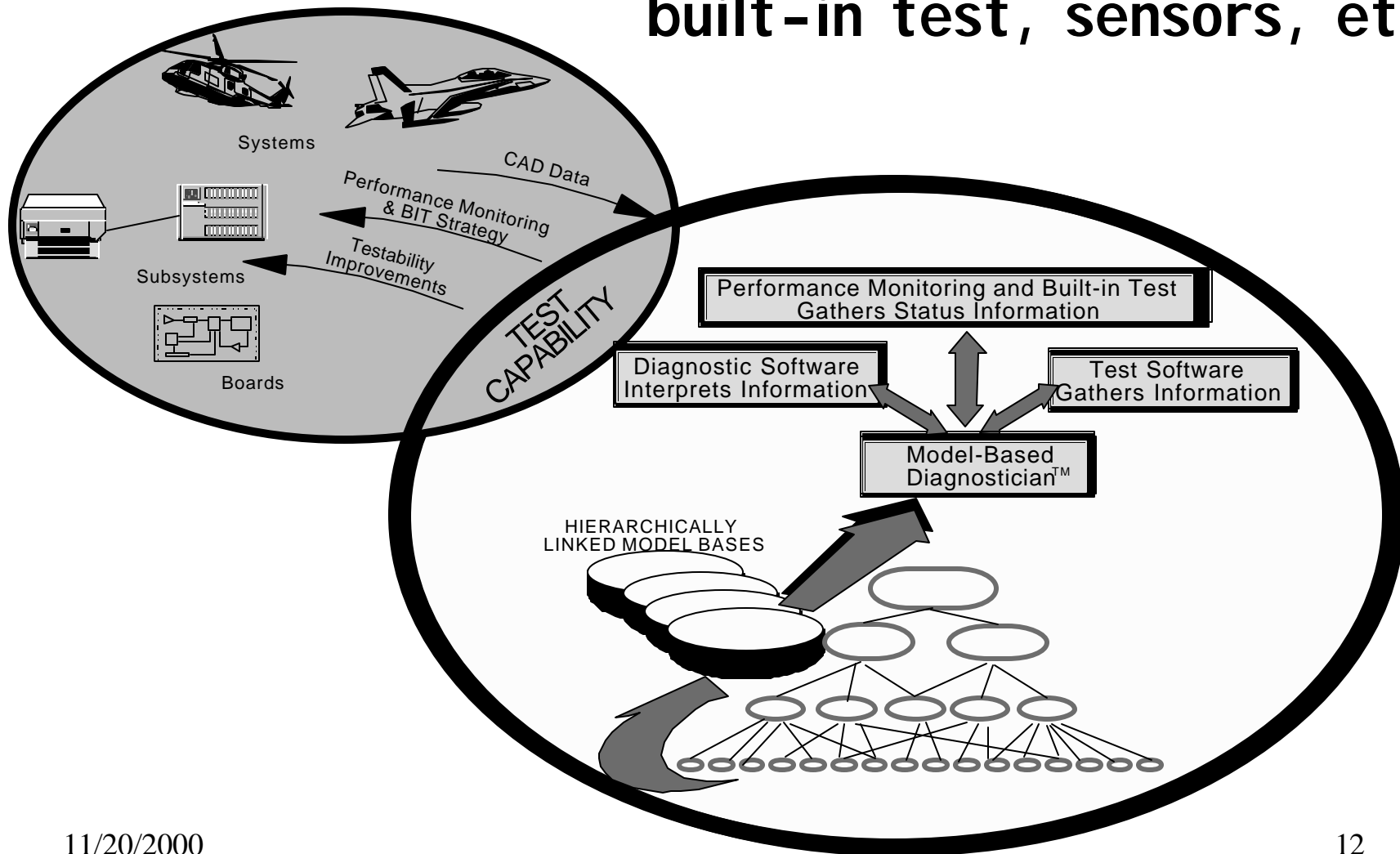
Mission Performance Parameters

System/Item Functions

Hardware/Software Design Elements

... and includes all test/diagnostic characteristics: testability, performance monitoring, built-in test, sensors, etc...

Systems

CAD Data

Performance Monitoring & BIT Strategy

Testability Improvements

Subsystems

Boards

TEST CAPABILITY

Performance Monitoring and Built-in Test Gathers Status Information

Diagnostic Software Interprets Information

Test Software Gathers Information

Model-Based Diagnostician™

HIERARCHICALLY LINKED MODEL BASES

And gives us the capability to track performance over time….

Synthesis

Analysis
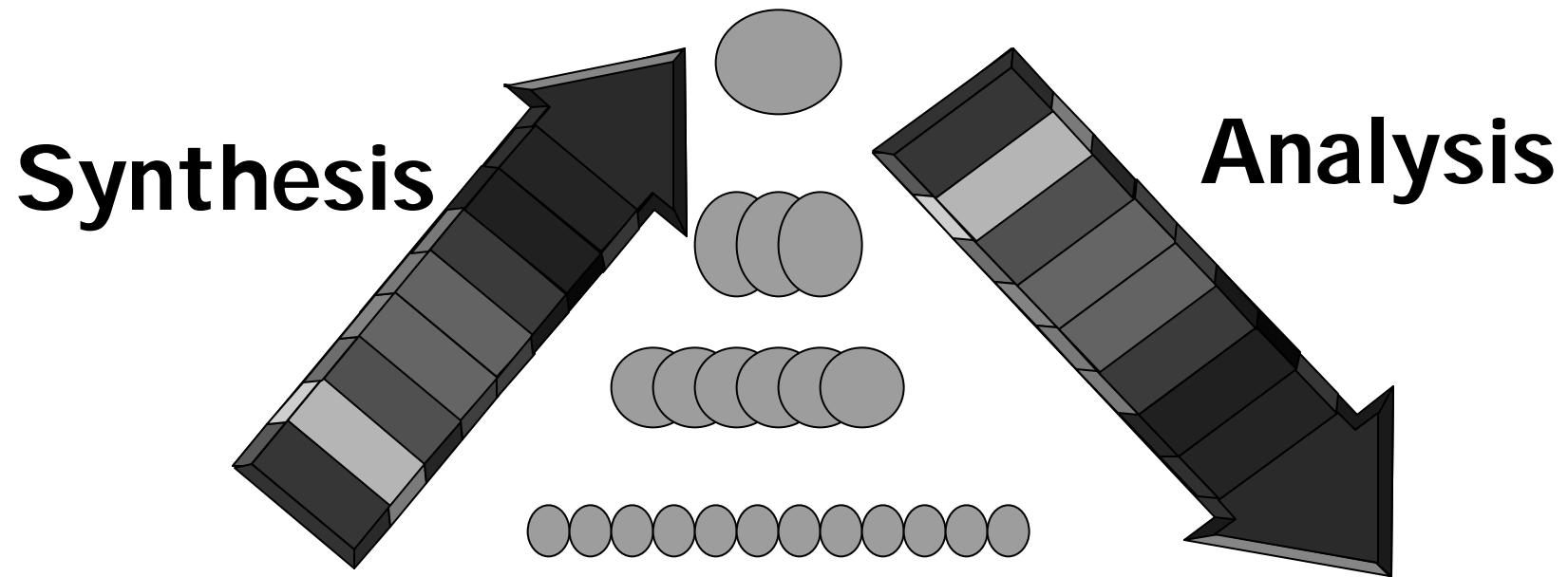
… and trace performance issues to fundamental "principals of design" …

…and, at the same time, generates the deployed diagnostic/prognostic and health management capability…
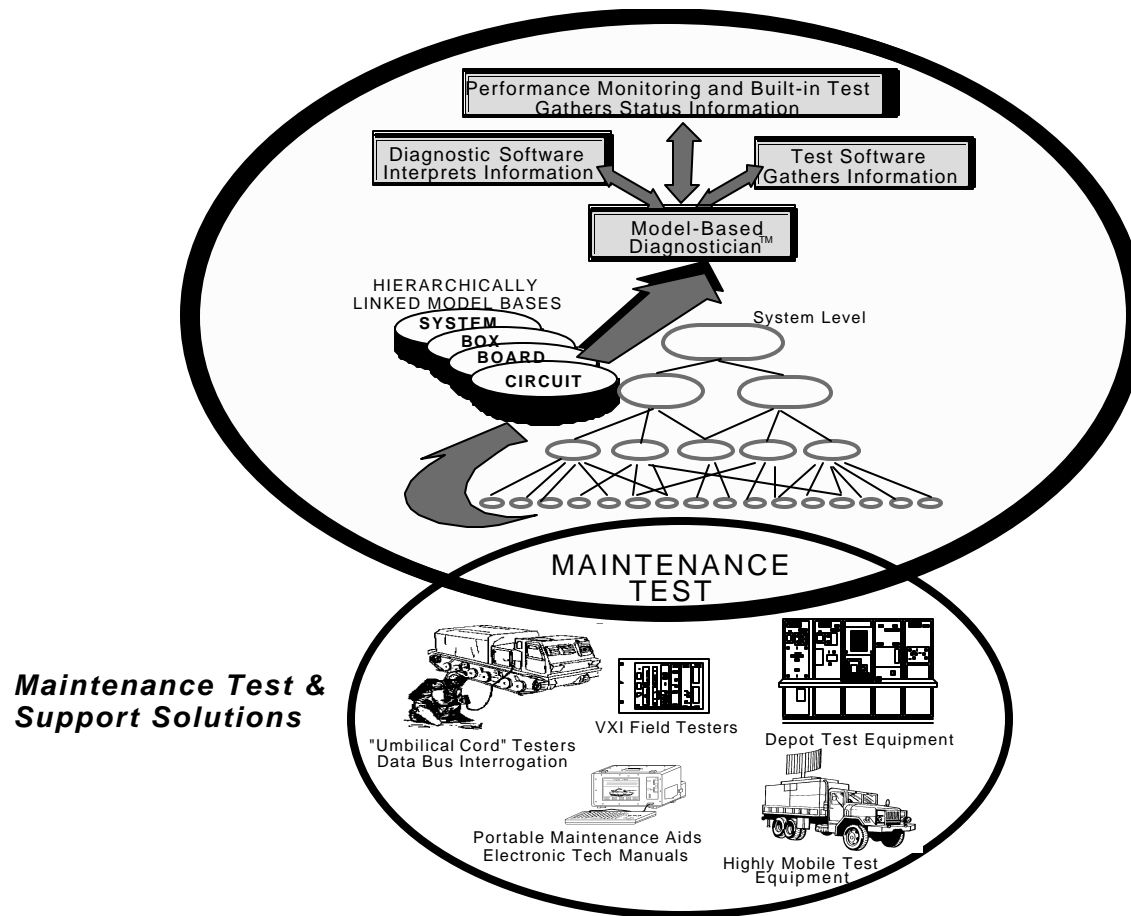
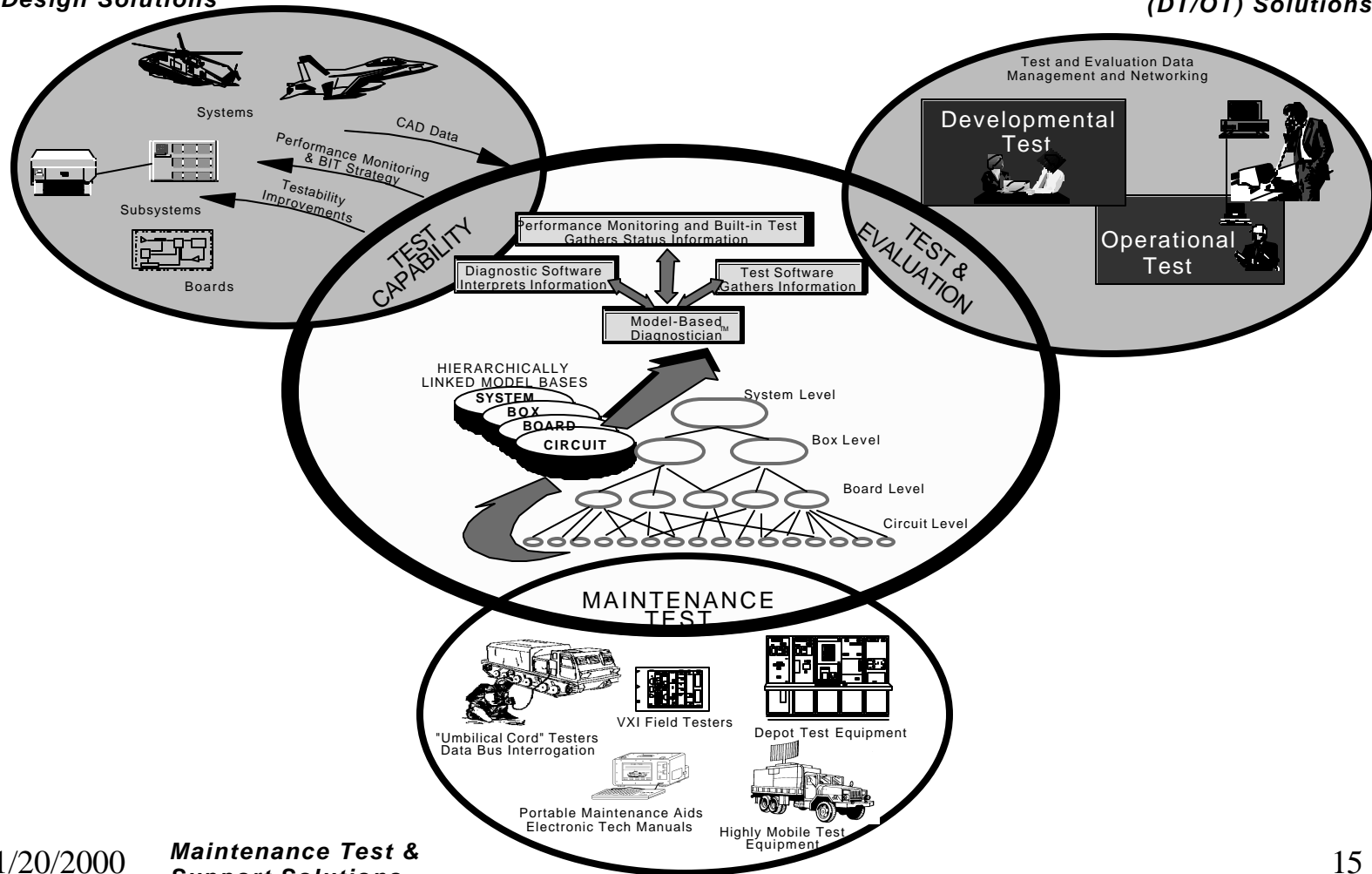# … and makes use of all DT/OT activities to mature this test, diagnostic and prognostic capability….

… to ensure that the fielded product meets its mission, performance, and supportability requirements.

Embedded Diagnostics Design Solutions

Test and Evaluation (DT/OT) Solutions

Systems

CAD Data

Performance Monitoring & BIT Strategy

Testability Improvements

Subsystems

Boards

Test and Evaluation Data Management and Networking

Developmental Test

Operational Test

TEST CAPABILITY

Performance Monitoring and Built-in Test Gathers Status Information

Diagnostic Software Interprets Information

Test Software Gathers Information

Model-Based Diagnostician™

TEST & EVALUATION

HIERARCHICALLY LINKED MODEL BASES

SYSTEM
BOX
BOARD
CIRCUIT

System Level

Box Level

Board Level

Circuit Level

MAINTENANCE TEST

"Umbilical Cord" Testers Data Bus Interrogation

VXI Field Testers

Depot Test Equipment

Portable Maintenance Aids Electronic Tech Manuals

Highly Mobile Test Equipment

Maintenance Test & Support Solutions

Today's technology supports this capability

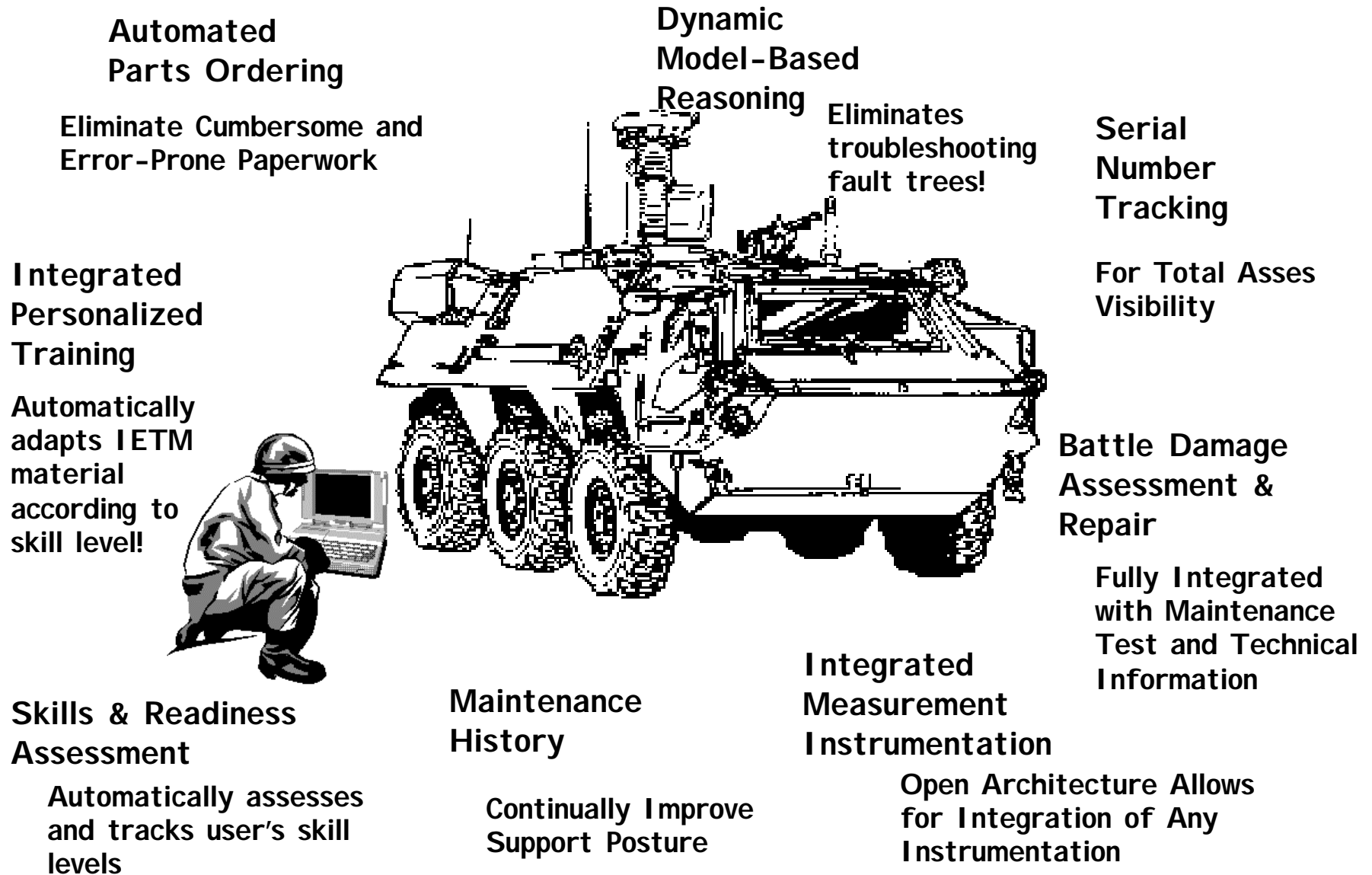**Automated Reasoning using Model-Based Reasoning**

System Development

Intelligent Diagnostics

✓ Model correlates all possible faults to all possible symptoms or test results

✓ Diagnostician provides fast, effective fault isolation in run-time.

✓ Combination results in *"Dynamic Diagnostics"*

Diagnostic Profiler

Diagnostician

Breaking the Wall Between Development and Maintenance

A Comprehensive Integrated Support Capability

**Automated
Parts Ordering**

Eliminate Cumbersome and
Error-Prone Paperwork

**Dynamic
Model-Based
Reasoning**

Eliminates
troubleshooting
fault trees!

**Serial
Number
Tracking**

For Total Asses
Visibility

**Integrated
Personalized
Training**

Automatically
adapts IETM
material
according to
skill level!

**Battle Damage
Assessment &
Repair**

Fully Integrated
with Maintenance
Test and Technical
Information

**Integrated
Measurement
Instrumentation**

**Skills & Readiness
Assessment**

Automatically assesses
and tracks user's skill
levels

**Maintenance
History**

Continually Improve
Support Posture

Open Architecture Allows
for Integration of Any
Instrumentation

MAINTENANCE TEST CHANGES FOCUS

NEW DIAGNOSTIC TECHNOLOGY REDUCES TEST REQUIREMENTS

➢ **UUT Fault Tree (Brute Force): Computer controlled test systems and simulated UUT operational environment to compare outputs and signals**
VS

➢ **Information-driven (Functional Analysis on design based data/information) -- Reduced test requirements, hierarchical models representing the UUT**

➢ **Design for both integrated diagnostics and prognostic/ predictive management --** *INTEGRATED INFORMATION RESOURCES*

TECHNICAL APPROACH

➢ **Design for testing, integrated diagnostics, and prognostic/predictive management (Software Tools: Diagnostician and Prognostics Framework)**
  - ➢ **Tie-in DT&E/OT&E with maintenance test requirement at development phase**

➢ **Maintenance Considerations**
  - ➢ **Use design based data/information to develop embedded diagnostics/prognostics, or off-line test program sets (TPS) and develop the true interactive electronic technical manuals (IETMs)**
  - ➢ **Develop *Integrated Information Resources***

TECHNICAL APPROACH (cont'ed)

➢ **System Test and Evaluation**
  - ✓ **Apply diagnostics and prognostics test for subsystems T&E**
  - ✓ **Use simulations for T&E interfaces**
  - ✓ **Use simulations for T&E launching interfaces**
  - ✓ **Automate assessment and scorekeep the DT&E/OT&E performance tests**

➢ **System Battle Damage Assessment (BDA) and Repair Training**
  - ✓ **Develop electronic BDA information (EBDAI)**
  - ✓ **Integrate maintenance test information with field exercises, IETMs, and EBDAI for BDA repair training**

Combine DT&E and maintenance test data, diagnostic knowledge database, and BDAR information to generate an _integrated_ soldier training package.
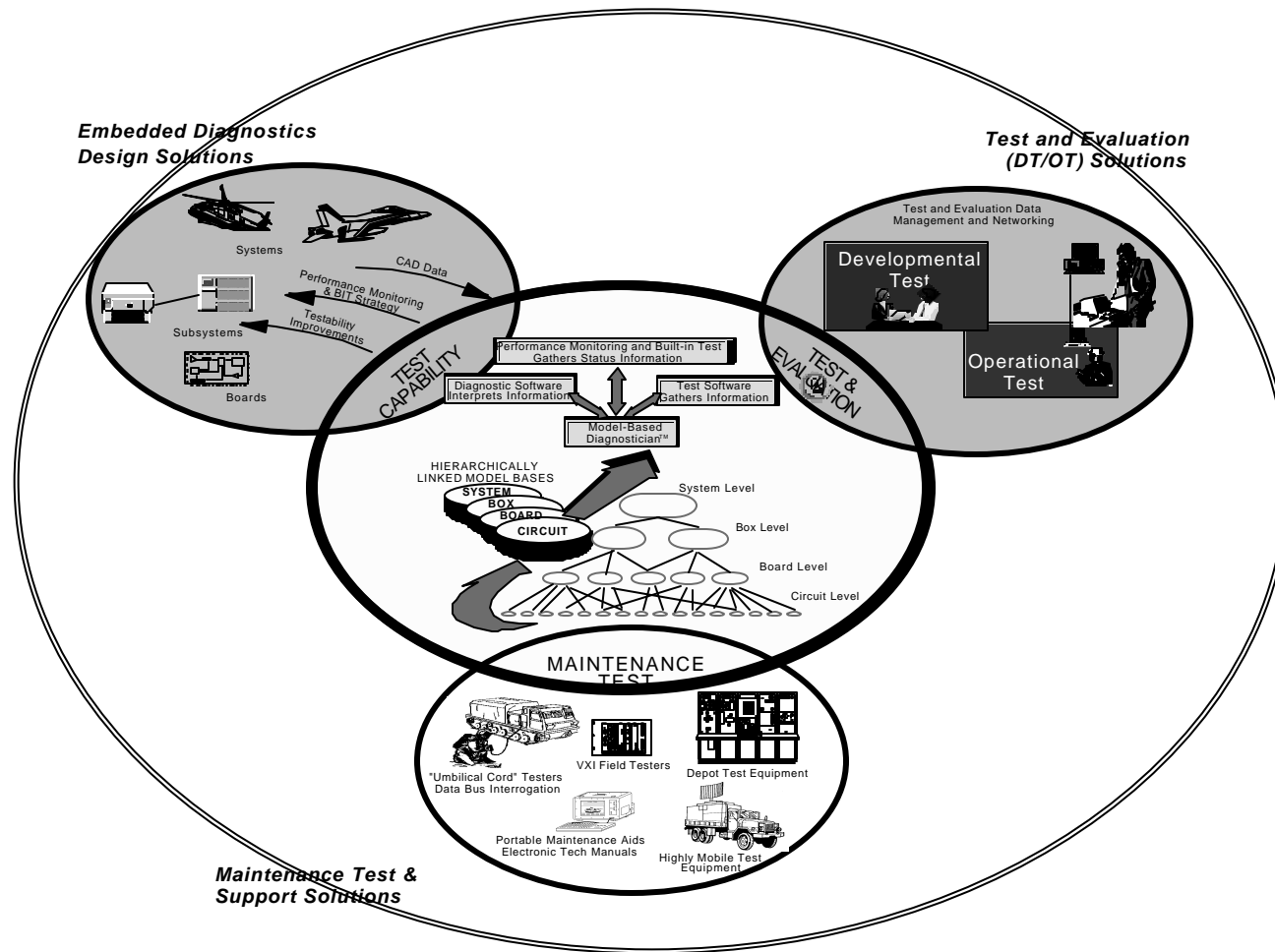
✓ **_VERSATILE_** warfighter power

✓ **_AGILE_** supportability and training

✓ **_AFFORDABLE_** sustainment.